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Computational models for the ultimate compressive strength analysis of a steel stiffened plate structure at cryogenic condition

Dong Hun Lee[a], Sung Hwan Noh[a], Jonas W. Ringsberg[b], and Jeom Kee Paik[a,c,d*]

[a]*Department of Naval Architecture and Ocean Engineering, Pusan National University, Busan, Republic of Korea*
[b]*Department of Mechanics and Maritime Sciences, Chalmers Univeristy of Technology, Gothenburg, Sweden*
[c]*The Korea Ship and Offshore Research Institute, Pusan National University (Lloyd's Register Foundation Research Centre of Excellence), Busan, Republic of Korea*
[d]*Department of Mechanical Engineering, University College London, London, UK*
** Corresponding author. jeompaik@gmail.com*

Abstract

The aim of the present study is to develop computational models for the ultimate strength analysis of stiffened plate structures under axial compressive loading and cryogenic condition. As the number of vessels fueled by liquefied natural gas (LNG) are increasing, there are potential hazards that LNG leaks to hull structures, leading to cryogenic condition with a temperature of -160 deg. C. Under extreme compressive loading, steel stiffened plate structures under cryogenic condition can exhibit brittle fracture before and after ultimate strength is reached. The authors have shown such an evidence through a physical model testing on a large scale stiffened plate structures, which was presented in a separate paper. In the present paper, computational models using nonlinear finite element method are developed to simulate the ultimate compressive strength behavior of stiffened plate structures at cryogenic condition, involving brittle fracture. The numerical computations are compared with test database obtained from the physical model testing.

Keywords: Steel stiffened plate structure; Ultimate compressive strength; Cryogenic condition; Brittle fracture; Nonliear finite element method modelling